A.D. 1861, 15th JANUARY. N° 114.

Screw Propellers.

LETTERS PATENT to Robert Wilson, of Patricroft, in the County of Lancaster, Engineer, for the Invention of "IMPROVEMENTS IN SCREW PROPELLERS, AND IN MACHINERY OR APPARATUS FOR ACTUATING THE SAME."

Sealed the 2nd July 1861, and dated the 15th January 1861.

PROVISIONAL SPECIFICATION left by the said Robert Wilson at the Office of the Commissioners of Patents, with his Petition, on the 15th January 1861.

I, ROBERT WILSON, of Patricroft, in the County of Lancaster, Engineer, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN SCREW PROPELLERS, AND IN MACHINERY OR APPARATUS FOR ACTUATING THE SAME," to be as follows, that is to say:—

This Invention relates to the arrangement and construction of what are known as screw propellers for moving ships or vessels through the water. The essential feature of this part of the present Invention is, that the improved propeller in its passage through the water presents the form of a solid of least resistance, and consequently that the particles of water as they impinge upon the face or foremost surface of the propeller glide smoothly and without resistance over a surface which in its cross section represents a long and narrow ellipse, with pointed extremities. Both the fore and aft surfaces of the propeller presenting this figure to the water, it follows that on rotatory motion

being communicated to it that the propeller will pass through the water as though the fluid were a solid, and in manner similar to that of an augur making its way through wood. With this arrangement the propeller passes through the water in a perfectly smooth and uniform manner, and as it does so without the usual disturbance and breaking up of the water, there is no loss of power, and slip is avoided. The blades or vanes of the propeller are, by preference, formed of malleable iron or of steel, the extremities being thinned off, so as to give a certain degree of flexibility to the blade, and at the same time combine lightness with the requisite degree of strength. The boss of the propeller is also formed so as to present no obstructive surface to the water or prevent its passing away unimpeded, and the propeller shaft is, by preference, formed of steel, to admit of its being made as small in diameter as possible.

The arrangement of the engine to which preference is given for driving the screw propeller is one in which the cylinders are arranged overhead, and are connected directly to the crank shaft beneath. The sole plate has four wrought-iron tubular columns arranged at the angles; these columns support an entablature on which the cylinders are placed. The piston rods are attached in the usual way by means of connecting rods to the crank shaft beneath the cylinders, and the crank shaft is connected by means of a coupling to the propeller shaft. On the free extremity of the crank shaft is a disc, having a laterally projecting crank pin, which is connected to a lever arranged on a level with the lower end of the cylinders. This lever works the air and bilge pumps. The disc keyed on the end of the crank shaft is fitted with radially projecting handles for handling or adjusting the propeller when the engines are not in motion. The extreme compactness of these engines admit of greater space being devoted to the stowage of coal or other purposes than can be obtained with engines of the diagonal or horizontal classes. In order to prevent priming, the boilers are arranged in the following manner:—On each side of the fire tubes, which extend longitudinally through the water space, there is arranged a metal plate, which extends from above the fire tubes downwards towards the furnace tubes, and by preference curving slightly inwards. Between the two ranges of fire tubes two other plates are disposed vertically, and at the bottom of these plates is a V-shaped plate, the edges of which do not quite touch the lower margins of the central parallel plates. With this arrangement the colder portions of the water in contact with the boiler shell pass down beneath the outer plates, and also down between the central plates, and out by the longitudinal openings. In this way the less heated portions of the water are caused to circulate in such manner as to be brought into contact

with the highly heated surfaces of the furnace and fire tubes, and thus effectually prevent priming. The steam is, if required, superheated by passing it into a steam jacket which encircles the smoke box immediately beneath the funnel. From the jacket the steam passes through a helical coil of copper pipe arranged within the smoke box, and through which the whole of the highly heated products of combustion pass on their way to the funnel.

This arrangement provides very effectively and economically for the superheating of the steam and depriving it of aqueous particles, and thus increasing its efficiency as a motive agent.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said Robert Wilson in the Great Seal Patent Office on the 15th July 1861.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, ROBERT WILSON, of Patricroft, in the County of Lancaster, Engineer, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Fifteenth day of January, in the year of our Lord One thousand eight hundred and sixty-one, in the twenty-fourth year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said Robert Wilson, Her special license that I, the said Robert Wilson, my executors, administrators, and assigns, or such others as I, the said Robert Wilson, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN SCREW PROPELLERS, AND IN MACHINERY OR APPARATUS FOR ACTUATING THE SAME," upon the condition (amongst others) that I, the said Robert Wilson, my executors or administrators, by an instrument in writing under my hand and seal, or under the hand and seal of one of them, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said Robert Wilson, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following

statement, reference being had to the accompanying Drawings, and to the letters and figures marked thereon, that is to say:—

My said Invention relates to the arrangement and construction of what are known as screw propellers for moving ships or vessels through the water. The essential feature of this part of the present Invention is that the improved propeller in its passage through the water presents the form of a solid of least resistance, and consequently that the particles of water as they impinge upon the face or foremost surface of the propeller, glide smoothly and without resistance over a surface which in its cross section represents a long and narrow ellipse with pointed extremities. Both the fore and aft surfaces of the propeller presenting this figure to the water, it follows that on rotatory motion being communicated to it, that the propeller will pass through the water as though the fluid were a solid, and in manner similar to that of an augur making its way through wood. With this arrangement the propeller passes through the water in a perfectly smooth and uniform manner, and as it does so without the usual disturbance and breaking up of the water, there is no loss of power, and slip is avoided. The blades or vanes of the propeller are, by preference, formed of malleable iron or of steel, the extremities being thinned off so as to give a certain degree of flexibility to the blade, and at the same time combine lightness with the requisite degree of strength. The boss of the propeller is also formed so as to present no obstructive surface to the water or prevent its passing away unimpeded, and the propeller shaft is, by preference, formed of steel, to admit of its being made as small in diameter as possible. The arrangement of the engine to which preference is given for driving the screw propeller is one in which the cylinders are arranged overhead, and are connected directly to the crank shaft beneath. The sole plate has four wrought-iron tubular columns arranged at the angles; these columns support an entablature on which the cylinders are placed. The piston rods are attached in the usual way by means of connecting rods to the crank shaft beneath the cylinders, and the crank shaft is connected by means of a coupling to the propeller shaft. On the free extremity of the crank shaft is a disc, having a laterally projecting crank pin, which is connected to a lever arranged on a level with the lower end of the cylinders; this lever works the air and bilge pumps. The disc keyed on the end of the crank shaft is fitted with radially projecting handles for handling or adjusting the propeller when the engines are not in motion. The extreme compactness of these engines admits of greater space being devoted to the stowage of coal or other purposes than can be obtained with engines of the diagonal or horizonal classes. In order to prevent priming the boilers are arranged in the following manner:—

On each side of the fire tubes, which extend longitudinally through the water space, there is arranged a metal plate, which extends from above the fire tubes downwards towards the furnace tubes, and by preference curving slightly inwards. Between the two ranges of fire tubes two other plates are disposed vertically, and at the bottom of these plates is a V-shaped plate, the edges of which do not quite touch the lower margins of the central parallel plates. With this arrangement the colder portions of the water in contact with the boiler shell pass down beneath the outer plates, and also down between the central plates and out by the longitudinal openings. In this way the less heated portions of the water are caused to circulate in such manner as to be brought into contact with the highly heated surfaces of the furnace and fire tubes, and thus effectually prevent priming. The steam is, if required, superheated by passing it into a steam jacket, which encircles the smoke box immediately beneath the funnel. From the jacket the steam passes through a helical coil of copper pipe arranged within the smoke box, and through which the whole of the highly heated products of combustion pass on their way to the funnel. This arrangement provides very effectively and economically for the superheating of the steam and depriving it of aqueous particles, and thus increasing its efficiency as a motive agent.

And in order that my said Invention of improvements in screw propellers, and in machinery or apparatus for actuating the same, may be properly understood, I shall now proceed to describe the several Figures on the two explanatory Sheets of Drawings which I have hereunto appended for the purpose of showing certain modifications under which my improvements may be judiciously carried out in practice, that is to say:—

Figure 1, on Sheet 1 of the accompanying Drawings, is a plan of one modification of a screw propeller constructed according to my improvements; Figure 2 is a partially longitudinal section of the same; and Figure 3 is a series of transverse sections taken through the lines marked 1 to 8 in Figures 1 and 2; Figure 4 is a side view, and Figure 5 an edge view of a screw propeller with its blades somewhat modified from the arrangement shown in Figures 1 and 2; Figure 6 is a partially sectional elevation of a boiler specially suited for the engines of screw propellers; and Figure 7 is a corresponding transverse section.

Figure 1 on Sheet 2 of the accompanying Drawings is an elevation showing the arrangement of the engine which I prefer to use for actuating screw propellers. Referring to Figures 1 to 5 on Sheet 1, the blades of the screw propeller are formed so as to approximate as nearly as possible to the form of the geometrical figure which is known as the solid of least resistance; the

object of this arrangement being that the propeller shall move through the water without disturbing it, and with the least possible resistance. To accomplish this end the blades A of the propeller are made with both surfaces corresponding in their curvature, as shown in the transverse sectional views, Figure 3. Thus, near the boss B of the propeller, the metal of the blade in its transverse section on the line 1 forms a long and comparatively narrow ellipse, having pointed extremities. From this part outwards to the margin the blade becomes gradually thinner and the ellipse is lengthened in proportion, so that on the line 8 the two surfaces become very nearly parallel, and thus from the margin of the blade to the boss no resistance whatever is offered to prevent the particles of water from gliding smoothly away; so also if the longitudinal section of the propeller blade be taken as an example of this system of construction, it forms, as shown in the sectional view, Figure 2, a narrow wedge-shaped figure, the best adapted for passing easily through the water. The boss B of the propeller is formed as small as possible consistent with the necessary degree of strength, and to obtain this, combined with the smallest amount of weight, the propeller is preferred to be made either of steel or of wrought iron. Where it is practicable it is preferred to use steel for the propeller shaft C, in order that the increased tenacity of this metal may admit of a corresponding reduction in the diameter of the shaft. In the side view of the propeller as delineated in Figures 4 and 5, the propeller blades A appear wider at the shank part near the junction of the blade with the boss or central part than in the view shown in Figure 1, but this difference is only apparent, and is caused by the twist of the blade and different angle under which it is viewed. The blades A are narrowed at the part D, by cutting away a portion of the metal, this admits of the angle of the blades being more easily changed to the required angle and adjusted to the slip so as to save power and not disturb the water during its rotatory motion. If made of steel these improved propellers will not require more than one-half the weight of metal as compared with cast iron or brass, and if wrought iron is the material made use of the weight need not exceed five-eighths of the weight of a similiar propeller formed of cast iron or brass. In this way then speed is gained by the improved form of the propeller, the little resistance that it offers in its rotatory movement enabling it to pass through the water as smoothly as though it were penetrating a comparatively solid body. This facility of motion is also attended with another advantage, for it effects a considerable saving in the amount of steam power required to impart to the propeller a given number of revolutions. In this way not only is the speed of the vessel greatly improved by the use of this form of propeller, but from the

smoothness of its motion the highly unpleasant vibration ordinarily imparted to the vessel when the screw propeller is driven at a high velocity is altogether avoided. The arrangement of boilers which I prefer to use in conjunction with the engines of screw propellers is represented in the vertical and transverse sectional views, Figures 5 and 6. These views embody my improvements in preventing "priming" and also the arrangement for superheating the steam. To prevent priming, two curved plates E are arranged longitudinally within the boiler; they are fitted outside the tubes F, and parallel, or nearly so, to the shell G of the boiler. Between the two ranges of fire tubes F are fitted the two vertical plates H, which diverge slightly from each other towards the upper part. Beneath the plates H are arranged the two narrow diverging plates I, which run nearly parallel with the curved surfaces of the furnace tubes K, a narrow longitudinal opening being left at the lower part of the duplex plates. As the water is heated by its contact with the tubes F and flues K, the heated portions ascend and displace the water of lower temperature, which is thus caused to descend in a current between the plates E and the shell of the boiler, and also between the central plates H. The descending current of water circulating between the plates E and the shell of the boiler is thus brought into contact with the highly heated surface of the tubular flues K; whilst the current which is descending between the plates H comes into contact with the diverging plates I, and is by them diffused over the more highly heated surfaces of the flues K. This arrangement of the plates thus provides for a continuous and uniform circulation of water, and the mode of bringing the less heated portions in contact with the flues K, so raises the temperature as to effectually prevent priming. The steam as it is evolved passes off by the pipe L into the steam chest or annular space surrounding the lower part of the chimney, here it gains an accession of heat from the body of highly heated gaseous matters passing off from the furnaces. The heat thus imparted is further augmented by causing the steam to pass through the tubular coil of copper pipe M, which is arranged within the lower part of the chimney. The steam passes in at the upper end of the tubular coil M, and out through the lower part of the steam chest to an external valve box, by means of which its supply to the engine is regulated. If preferred a second steam pipe is fitted in direct communication with the upper part of the boiler, which conveys the saturated steam into a valve box arranged in connection with the pipe proceeding from the valve box of the superheating apparatus. In this way the superheated and the saturated steam may be mixed or blended on their way to the engine, and supplied thereto in the proportions found most economical in working.

Wilson's Improvements in Screw Propellers.

The arrangement of the engines which I prefer to use for the purposes of screw propulsion is delineated in Sheet 2 of the accompanying Drawings, Figure 1 being a side elevation, and Figure 2 a plan of the same.

On the sole plate N are arranged four tubular columns supporting an entablature on which the cylinders O are arranged. The steam passes from the steam pipe into the valve boxes P, in which are fitted the rotatory expansion valves for which British Letters Patent were granted to me and J. W. Child, and dated 12th September 1853. By means of these valves the steam may be cut off at any portion of the stroke, and the mechanical arrangement for effecting this will be presently referred to. The piston rods Q work out through the usual stuffing boxes in the end covers, and are connected by means of the rods R to the crank shaft S. On one extremity of this shaft is a disc T, in which is fitted a crank pin U, which serves to connect it by means of the rod V and lever W with the horizontal shaft X, which is carried in pedestal bearings arranged on the entablature. From the shaft X the air pump Y, as also the feed and bilge pumps Z, are worked. The disc T has a series of holes formed in its periphery to admit of the crank shaft being turned by means of a hand lever when the engines are not in motion. This arrangement is very useful either for adjusting the valves or to ship or unship the propeller, and for other purposes. To the opposite extremity of the crank shaft S is keyed a bevel wheel *a*, which gears with the pinion *b* on the lower extremity of the oblique shaft *c*; the footstep and collar bearings of this shaft are carried in brackets projecting laterally from the sole plate and entablature. The bevel pinion *d* on the upper extremity of the shaft *c* gears with the wheel *e* on the horizontal shaft *f*, which extends across the front of the engines. On the shaft *f* are two screw wheels *g*, which give motion to the corresponding wheels *h* on the valve spindles *i*, and in this way a uniform rotatory movement is communicated to the valves in the boxes P. The vertical adjustment of the valves for the regulation of the "cut off" is obtained from the worm or endless screw *j*, which is carried in a bracket arranged on the sole plate N, and is actuated by means of a winch handle. The worm *j* gears with a worm wheel *k* on the horizontal shaft *l* extending across the engine and parallel with the shaft *f* above it. The shaft *l* has fitted to it two small pinions, which gear respectively with the vertical racks *m*, the upper parts of which form the footstep bearings of the spindles *i*. Thus by simply turning the worm *j* the valve spindles and their connected valves are simultaneously raised or lowered at pleasure whilst the engines are in motion. The steam after performing its work in the cylinder passes away by the exhaust *n*, which opens into a valve box *o*, in which is fitted a stop valve; the lower part of the valve box opens

into the discharge pipe *p*, which communicates with the hot well in the usual way. Engines arranged according to this plan are particularly well adapted for screw propulsion, as they occupy but comparatively little space, and are free from vibration; they are also easily accessible in all the parts.

Having now described and particularly ascertained the nature of my said Invention, and the manner in which the same is or may be used or carried into effect, I would observe in conclusion, that what I consider novel and original, and therefore claim as the Invention secured to me by the herein-before in part recited Letters Patent, is,—

First, the system or mode of constructing screw propellers in such manner as to offer the least possible resistance in passing through the water, which is obtained by forming the blades in the manner herein-before described and delineated in the accompanying Drawings.

Second, the system or mode of preventing "priming" in steam boilers by means of internal plates arranged for facilitating the circulation of the water, and also the apparatus for superheating the steam, as herein-before described and shown in the accompanying Drawings.

Third, the general arrangement and construction of steam engines for actuating screw propellers, as herein-before described and delineated in the accompanying Drawings.

In witness whereof, I, the said Robert Wilson, have hereunto set my hand and seal, this Twelfth day of July, One thousand eight hundred and sixty-one.

ROBERT WILSON. (L.S.)

LONDON:
Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1861.

FIG. 6